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Molecular phylogeny of placodioid lichen-forming fungi reveal a new genus, *Sedelnikovaea*

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Abstract — A molecular phylogeny based on ITS1/ITS2 and mtSSU DNA sequences is presented for lichen-forming fungi in *Protoparmeliopsis* and its distant relative *Sedelnikovaea* gen. nov. The positions of the two genera in the phylogenetic tree of the families *Lecanoraceae* and *Lecideaceae* are discussed. The new combination *Sedelnikovaea baicalensis* (≡ *Lecanora baicalensis*) is proposed. The unique *Sedelnikovaea*-type ascus is described and illustrated. *Sedelnikovaea baicalensis* and *Zwackhiomyces zarei* are for the first time recorded from China.

Key words — *Biatora*, *Rhizoplaca*, *Protoparmelia*, *Candelariella*, *Steinia*, *Pycnora*

Introduction

The lichen-forming fungal genus *Protoparmeliopsis* comprises a total of ca. 44 species (Santesson 2004; Kondratyuk 2010; Kondratyuk et al. 2012, 2013 b). After Arup & Grube (2000) provided the first molecular data for *Protoparmeliopsis*, five new species and 42 new combinations have been proposed in the genus (Kondratyuk 2010; Kondratyuk et al. 2012, 2013b; Santesson 2004).

Protoparmeliopsis is not currently classified in the *Lecanoraceae* (Lumbsch & Huhndorf 2007, 2010) due, in part, to lack of molecular data and unresolved relationships within *Lecanora* sensu lato. Sequences from only three species — *P. achariana* (A.L. Sm.) Moberg & R. Sant., *P. macrocyclos* (H. Magn.) Moberg

& R. Sant., and *P. muralis* (Schreb.) M. Choisy — are available in GenBank. Several species recently described in *Protoparmeliopsis* (or recently combined in the genus based on morphology; Kondratyuk 2010, Kondratyuk et al. 2012, 2013 b) are here included in a molecular analysis.

Material & methods

Specimens were prepared using standard microscopical techniques: specimens were hand-sectioned under Nikon SMZ645 dissecting microscope, examined under Nikon E200 and Olympus BX51 microscope, and photographed using the Olympus DP-Soft photo program.

Table 1. Specimens included in the phylogenetic analysis

Taxon name	Country / voucher	ITS1/ITS2	12S SSU mt DNA
Adelolecia pilati	Norway?, Ekman 3373 (BG)		AY567713
	Norway?, Ekman 3373 (BG)		AY300874
Aspicilia caesiocinerea	AFTOL-ID 653		DQ986892
Aspicilia cinerea	AFTOL-ID 647		DQ986890
	Sweden	EU057899	
Boreoplaca ultrafrigida	China		HQ026247
	AFTOL-ID 1702		DQ986813
	Russia		AY853312
Circinaria calcarea	Sweden	EU057898	
	Sweden		AY853310
	Austria?/ Wilfling (GZU)	AF332108	
	AFTOL-ID 1358		DQ986876
Circinaria desertorum	USA	EU057905	
	Russia		HM060689
Circinaria hispida	Iran	HQ389197	
	SK A12, Ukraine, Kharkiv oblast, Dvorychansky district, 'Korobchyno' zakaznik, 19.vi.2013 M. Kryvokhyzhaya (KW-L)		**KP059052**
	SK A15, Ukraine, Kharkiv oblast, Dvorychansky district, 'Korobchyno' zakaznik, 19.vi.2013 M. Kryvokhyzhaya 2 (KW-L)		**KP059053**
	Turkey		HM060722
Farnoldia jurana	Austria		GU074511
Hypocenomyce scalaris	AFTOL-ID 1025	HQ650632	
	Sweden		AY853325
	United Kingdom	FR799187	
	Sweden		AY853326
	AFTOL-ID 687		DQ912274
Japewia tornoensis	Canada	EF495163	
	?/ Printzen s. n.	HQ650656	
	Canada		HQ660559
Lecanora achroa	Thailand	JN943715	
	Australia	JN943719	
Lecanora albescens	Poland?/ Kubiak Jan. 2009 (KRAM)	JQ993727	
Lecanora allophana	Norway?, Ekman 3434 (BG)		AY567710
Lecanora argentata	Thailand	JQ782704	

Taxon name	Country / voucher	ITS1/ITS2	12S SSU mt DNA
Lecanora bicincta	Austria?/ U. Trinkaus 102 (GZU)	AY541264	
Lecanora caesiorubella	Australia		JQ782672
Lecanora campestris	Sweden?/ U225	AF159930	
	Sweden?/ U514		DQ787362
Lecanora carpinea	Sweden?/ U507		DQ787364
	Austria?/ J. Pruegger 61232 (GZU)	AY541247	
Lecanora crenulata	Poland?/ Sliwa 4087 (KRAM)	JQ993725	
Lecanora contractula	AFTOL-ID 877	HQ650604	
	AFTOL-ID 877		DQ986898
Lecanora dispersa	Hungary?/Lőkös Jan. 2009 (KRAM)	JQ993733	
Lecanora dispersoareolata	Austria?/ M124	AF070016	
Lecanora farinacea	Austria?/ U. Trinkaus 115 (GZU)	AY541261	
	Australia	JN943725	JQ782672
	Australia		JQ782670
Lecanora flavopallida	Australia	JN943723	JQ782674
	Australia		JQ782673
Lecanora fuscescens	Hauck s. n.	HQ650652	
Lecanora gangaleoides	USA		JQ782676
Lecanora glabrata	Sweden?/ U444		DQ787360
Lecanora hagenii	Hungary?/ Lőkös Jan. 2009 (KRAM)	JQ993735	
Lecanora hybocarpa	?/ Lumbsch s.n. (F)		EF105417
Lecanora intricata	Austria ?	AY398703	
Lecanora intumescens	Norway?, Ekman 3162		AY567715
Lecanora kenyana	Kenya	JQ900618	
Lecanora novomexicana	USA	HM577255	
Lecanora paramerae	?/ Lumbsch s.n. (F)		EF105418
Lecanora perpruinosa	Sweden?/ U176	AF070025	
Lecanora polytropa	Antarctica, Hur ANT050752	DQ534470	
Lecanora reuterii	Poland?, Sliwa 4113 (KRAM)	JQ993741	
Lecanora rupicola	Spain	DQ451670	
Lecanora semipallida	Poland?/ Sliwa 4102 (KRAM)	JQ993755	
Lecanora subcarpinea	Slovenia	DQ451657	
Lecanora sulphurea	Sweden?/ U508		DQ787356
Lecanora swartzii subsp. *caulescens*	Austria?/ M. Grube s.n. (GZU)	AY541272	
Lecanora swartzii	Austria	DQ451655	
Lecanora tropica	Kenya	JN943718	
	Thailand	JN943720	JQ782699
Lecanora valesiaca	Sweden?/ U512		DQ787350
Lecidea fuscoatra	AFTOL-ID 589	HQ650707	
	Sweden, Arup L02723 (Hb. Arup)		HQ660567
	Turkey	HQ605929	
	Turkey	HQ605927	
	Sweden?/ Wedin 6860 (UPS)		AY756401
	AFTOL-ID 589		DQ912275
Lobothallia alphoplaca	USA	JX306737	
	USA	JX306739	
Lobothallia melanaspis	Norway	JF825524	
	Sweden		HM060688
Lobothallia radiosa	Sweden	JF703124	
	Switzerland		DQ780274
Lobothallia recedens	Sweden		HM060724

Taxon name	Country / voucher	ITS1/ITS2	12S SSU mt DNA
Megaspora verrucosa	Austria? /1996, Trinkaus (GZU)	AF332121	
	Austria?/ Hafellner 48544 & Ivanova (GZU)	AF332122	
	Sweden		HM060687
	Iran		JQ797483
Protoparmelia atriseda	USA	KF562190	
Protoparmelia badia	Austria	KF562191	
	Sweden?/ U167	AF070023	
	Australia		AF351179
	Austria	EU075540	
	?/ Lumbsch s.n. (F)		EF105420
Protoparmelia cupreobadia	USA	KF562192	
Protoparmelia isidiata	USA	JF821184	
Protoparmelia montagnei	BCC-Lich 13178	AF101277	
Protoparmelia picea	Norway	KF562194	
Protoparmelia psarophana	BCC-Lich 13180	AF101279	
Protoparmeliopsis achariana	Sweden?/ U155	AF070019	
	Sweden?/ U525		DG787342
Protoparmeliopsis garovaglii	Austria?/ M107	AF189718	
Protoparmeliopsis macrocyclos	Sweden?/ U273	AF159933	
Protoparmeliopsis muralis	SK 765, Romania, 2011 J.-S. Hur (RO11-130) (KoLRI)	**KP059048**	**KP059054**
	Sweden?/ U509		DQ787340
	Poland	HM209239	
	Schmull s. n.	HQ650653	
Protoparmeliopsis zarei	SK 480, Iran, Esfahan Province, Mooteh Wildlife refuge, 50°39′56″E 33°25′34″N, 2510 m alt., 21.VII.2010 B. Zarei-Darki (1111) (KW-L)	**KP059049**	**KP059055**
	SK 481, Iran, Esfahan Province, Mooteh Wildlife refuge, 50°39′56″E 33°25′34″N, 2510 m alt., 21.VII.2010 B. Zarei-Darki (1108) (KW-L)		**KP059056**
Pycnora sorophora	Sweden, Hermansson 7903a (UPS)	FJ959357	AY853338
Pycnora xanthococca	Sweden, Hermansson 11849 (UPS)	AY853388	AY853339
Pyrrhospora quernea	Norway?, Ekman 3019 (BG)	AF517930	AY567712
	Norway?, Ekman 3019 (BG)		AY300908
Pyrrhospora sanguinolenta	Australia, Elix 28835 (F)	EU075548	
Ramboldia brunneocarpa	Australia	EU075542	
Ramboldia stuartii	Australia	EU075549	
Rhizoplaca bullata	Spain		AY464070
Rhizoplaca chrysoleuca	USA	HM577253	
	Sweden?/ U503		DQ787354
	China, Wei, 3, 8/5/2002	AY509799	
Rhizoplaca haydenii	USA	HM577302	
Rhizoplaca idahoensis	USA	HM577297	
Rhizoplaca melanophthalma	Switzerland	JX948232	
	Sweden?/ U519		DQ787352
Rhizoplaca occulta	USA	HM577307	
Rhizoplaca parilis	Chile	JX948227	
Rhizoplaca peltata	China, Wei, 22-c, 2001	AY530887	
	China, Guo, 3557, 8/1/2003	AY509802	
Rhizoplaca polymorpha	USA	JX948194	

Taxon name	Country / voucher	ITS1/ITS2	12S SSU mt DNA
Rhizoplaca porteri	USA	HM577381	
Rhizoplaca shushanii	USA	HM577294	
Rhizoplaca subdiscrepans	China, Wang, 13-2, 8/4/2002	AY509789	
Scoliciosporum chlorococcum	United Kingdom	FR799323	
	Norway?, Ekman 3390 (BG)		AY567768
Scoliciosporum umbrinum	Austria?, A. Wilfling 2873 (GZU)	AY541277	
	Norway?, Ekman 3005 (BG)		AY567719
	Norway?, Ekman 3005 (BG)		AY300911
Sedelnikovaea baicalensis	SK A13, China, Inner Mongolia, 42°01′011″N, 116°17′738″E, 1434 m alt., 8.viii.2009 J.-S. Hur & X.Y. Wang CH090322 KoLRI 010936	**KP059050**	**KP059057**
	SK 776, China, Inner Mongolia, 42°01′011″N, 116°17′738″E, 1434 m alt., 8.viii.2009 J.-S. Hur & X.Y. Wang CH090322 KoLRI 010936	**KP059051**	**KP059058**
	SK A18, China, Inner Mongolia, 43°36′272″N, 116°43′242″E, 1260 m alt., 10.viii.2009 J.-S. Hur & X.Y. Wang CH090352 (KoLRI 010966)		**KP059059**
Steinia geophana	Germany		JN222812
Xanthomendoza mendozae	Chile	EU681351	
	Chile	EU681349	EU680937
	Argentina	EU681350	EU680938
Xanthomendoza kashiwadani	Chile		EU680936
Xylopsora friesii	United Kingdom Sweden	FR799184	 AY853324

Results

We submitted data on *P. muralis* and *P. zarei* S.Y. Kondr. into GenBank for the first time, as ITS rDNA and 12SSU mtDNA sequence analyses confirm both species within *Protoparmeliopsis*. Phylogenetic analysis also shows that another Asian species, *P. baicalensis* (Zahlbr.) S.Y. Kondr., is outside the genus and very distant from *Protoparmeliopsis*. Our anatomical examination of material of *'Protoparmeliopsis' baicalensis* revealed that this taxon is characterized by a unique ascus-type (Pl. 3), which we henceforth refer to as the *Sedelnikovaea*-type. Consequently we propose a new genus, *Sedelnikovaea,* for this species, *S. baicalensis*.

Sedelnikovaea baicalensis and *Zwackhiomyces zarei* S.Y. Kondr. (KoLRI 10971, on *Rhizoplaca chrysoleuca*, see below under specimens examined) are for the first time recorded from China.

Taxonomy & phylogeny

Protoparmeliopsis M. Choisy, Bull. Soc. Bot. France 76: 523 (1929).

Type species — *Lichen muralis* Schreb. [≡ *Protoparmeliopsis muralis*]

Thallus commonly distinctly placodioid. Apothecia lecanorine. Asci of *Lecanora*-type. Ascospores hyaline, simple.

Protoparmeliopsis comprises approximately 44 species. For a detailed description of the genus and its history, see Kondratyuk (2010).

Molecular phylogeny — As a monophyletic group *Protoparmeliopsis* has high bootstrap support based on results from nuclear (ITS1/ITS2) and mitochondrial (12S SSU) DNA sequence analyses that included four *Protoparmeliopsis* species (Figs 1, 2).

The status of such species as *P. macrocyclos* and *P. garovaglii* (Körb.) S.Y. Kondr. still requires further study.

Protoparmeliopsis is not generally accepted (Lumbsch & Huhndorf 2007, 2010), probably because the *Lecanora* s. lat. clade itself has a rather high bootstrap support (see Pl. 2). However, relationships among lineages within *Lecanora* s. lat. remain largely unresolved, and improved sampling is required to circumscribe genera within this group adequately.

A parallel case is the *Dufourea* s.lat. clade in *Xanthorioideae, Teloschistaceae* (Kondratyuk et al. 2014b, and Fedorenko et al. 2009, 2012; Kondratyuk et al. 2013a as *Xanthodactylon* s.lat. clade). However within this clade *Dufourea* Ach. s.str., *Jackelixia* S.Y. Kondr. et al., *Ovealmbornia* S.Y. Kondr. et al., *Langeottia* S.Y. Kondr. et al., and *Xanthokarrooa* S.Y. Kondr. et al. have strong individual bootstrap support values, with each monophyletic branch also characterized by a unique set of morphological, anatomical, and biochemical characters.

Similarly ITS1/ITS2 nrDNA (Pl. 1) and 12S SSU mtDNA (Pl. 2) analyses strongly support *Protoparmeliopsis* within the *Rhizoplaca*/*Protoparmeliopsis* clade. The genus is probably as polyphyletic as *Rhizoplaca* Zopf (Arup & Grube 2000, Arup et al. 2007, Leavitt et al. 2011, 2013), *Protoparmelia* M. Choisy (Lendemer & Lumbsch 2008, Papong et al. 2011, Sing et al. 2013), and *Lecanora* Ach. (Grube & Blaha 2003, Grube et al. 2004, Lumbsch et al. 2012, Sliwa et al. 2012).

Sedelnikovaea S.Y. Kondr., M.H. Jeong & Hur, **gen. nov.**

MycoBank 810705

Differs from *Protoparmeliopsis* in having a unique type of ascus in some respects similar to *Candelariella*- and *Biatora*-type, and by its close molecular similarity to members of the *Lecideaceae*.

Type species — *Lecanora baicalensis* Zahlbr. [≡ *Sedelnikovaea baicalensis*]

Etymology — honouring lichenologist Nellia Vasiljevna Sedelnikova (Novo-sibirsk, Russia) in recognition of her contribution to our knowledge of Asian lichen flora.

Thallus distinctly placodioid, rosette-like, apothecia lecanorine, asci of *Sedelnikovaea*-type, 8-spored; ascospores simple, hyaline.

Taxonomic position — This new genus is proposed for the single species *Sedelnikovaea baicalensis*, morphologically similar but only distantly related to species in the putative genus *Protoparmeliopsis*. Molecular data (see

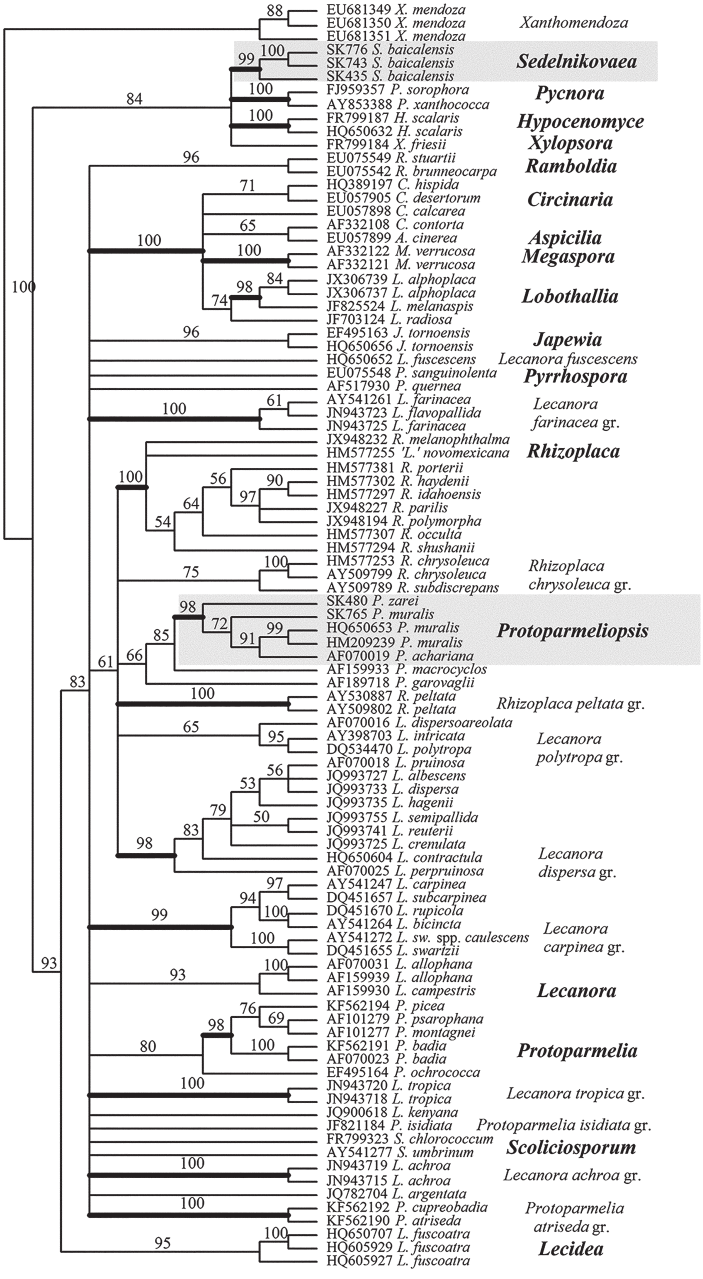

Plate 1. The phylogenetic tree of *Protoparmeliopsis* and *Sedelnikovaea* and representatives of *Lecanoraceae* and *Lecideaceae*, based on the ITS1/ITS2 gene of nuclear DNA.

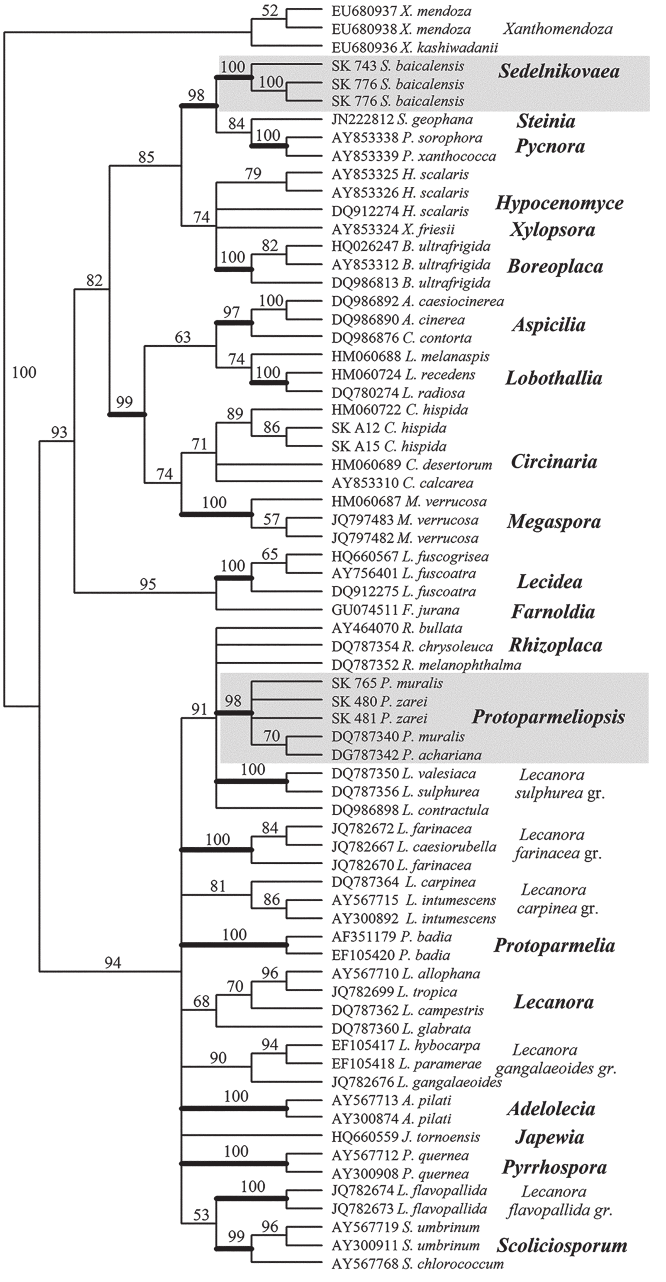

Plate. 2. The phylogenetic tree of *Protoparmeliopsis* and *Sedelnikovaea* and representatives of *Lecanoraceae* and *Lecideaceae*, based on the 12S SSU gene of mitochondrial DNA.

below) indicate a close relationship with the *Lecideaceae* or *Megasporaceae*. Morphological and anatomical comparisons show important differences from *Protoparmeliopsis* species, primarily a somewhat grey-brownish (instead of greenish) thallus and possession of a unique *Sedelnikovaea*-type ascus, described below.

Sedelnikovaea baicalensis (Zahlbr.) S.Y. Kondr., M.H. Jeong & Hur, **comb. nov.**
MycoBank 810706 Pl. 3–4

≡ *Lecanora baicalensis* Zahlbr., Trav. Sous-Sect. Troitzkossawsk.-Khiakta, Sect. Pays d'Amour, Soc. Imp. Russe de Géogr. 12: 85. 1911 ["1909"].

≡ *Placolecanora baicalensis* (Zahlbr.) Kopach., Nov. Sist. Niz. Rast. 9: 293. 1972.

≡ *Protoparmeliopsis baicalensis* (Zahlbr.) S.Y. Kondr., Ukr. Botan. Zhurn. 96 (6): 876. 2012.

Thallus crustose, rosette-like, up to 1–2.5 cm across, often forming larger aggregations, rather thick, in section to 1 mm thick, densely attached to the substrate, distinctly lobate in peripheral zone and sometimes areolate in the centre, upper surface rough to slightly verruculose, matt to slightly shiny, grayish brown to brownish, yellow-brownish or ochraceous-brown. Lower surface dark brown to blackish-brown. Apothecia up to 1–1.5 mm diam., lecanorine (in section zeorine), mainly rounded, attenuated at the basis, disc shiny at first, subconvex to convex when mature, light-brown to light reddish brown; thalline margin narrow, entire to crenulate, sometimes disappearing in senescence. True exciple up to 30 µm thick in lateral portion and somewhat indistinct in basal portion. Hymenium up to 50–70 µm high, epihymenium 15–20 µm thick, brownish. Subhymenium up to 100 µm thick, underlying an algal layer up to 50–80 µm thick. Paraphyses rather lax. Asci 50–57 × (13–) 15–18(–20) µm. Ascospores ellipsoid, 11-18 × 5-7 µm. Thallus K–, C–, Pd+ slightly reddish.

Specimens examined – **RUSSIA. Chita region (oblast)**, Kyrinsky district, 2 km SW of Chita-Khapcheranga junction, 49°45′21.40″N 112°20′08.60″E, 1184 m alt., shale rocks, 28 July 2008 Yakovchenko (VBGI); Sokhondinskiy biosphere reserve, vicinity of 'Buninda' Forest Station, 49°42′20.46″N 111°21′55.36″E, 1294 m alt., experimental plot 31, Steppe S-facing rocky slope with granitoid stones, 24 July 2008 Yakovchenko (VBGI); Sokhondinskiy biosphere reserve, vicinity of 'Agutsa' Forest Station, 49°39′57.16″N 111°25′39.11″E, 1130 m alt., Steppe S-facing rocky slope with *Pinus sylvestris* in the upper part of the slope near the Station, 02 September 2009 Yakovchenko (VBGI); Sokhondinskiy biosphere reserve, vicinity of 'Agutsa' Forest Station, 49°39′55.03″N 111°25′39.42″E, 1115 m alt., S-facing rocky slope with granitic gneissic rocks near the Station, 20 July 2008 L. Yakovchenko (VBGI); "Gornaya Step" Protected Area, division of Sokhondinskiy biosphere reserve, 14 km S of Kira Village, 49°24′N 112°03′E, 970 m. alt., vicinity of 'Gazultiy' Forest Station, 'Sukhaya Padj' locality, Multiherb prairie with fragments of kharganat-type of vegetation on the S-facing rocky slope, 03 August 2005 Yakovchenko (VBGI); **Zabaikalsky Territory (kray)**, Ononskiy District, road from Verkhniy Sharanay Village to Undino Posel'e Village, 3.5 km W of Zarya

Village, 51°08′51.10″N 116°01′35.70″E, 606 m alt., steppe S-facing slope with shrubs and rocks, 01 August 2008 Yakovchenko (VBGI); Tsasucheyskiy District, road from Nizniy Tcasuchey to Aginskoe, 500 m N of the Bridge on Onon River, vicinity of "Krasny Bator" nature monument, 50°31′45.00″N 115°01′19.10″E, 631 m alt., steppe slope with granitic rocks, 30 July 2008 Yakovchenko (VBGI); Akshinskiy District, 11 km NE of Mogoytuy Village and 10 km N of the junction to Nizniy Zasuchey, 50°24′35,10″N 113°58′04,40″E, 768 m alt., vegetation of kharganat-type (cereals – *Filifolium* – herb steppe with *Armeniaca sibirica*) and shale rocks on S-facing slope, 28 July 2008 Yakovchenko (VBGI); Krasnokamenskiy District, 6.9 km NNE of Tselinniy Village, 50°19′00.60″N 118°08′41.30″E, 710 m alt., Spurs of Klichkinskiy Range, steppe top of spur with granitic gneissic rocks, 05 August 2008 Yakovchenko (VBGI). **CHINA. Neimenggu Province**, Duolun county, Shisanlitan, 42°02.560′N 116°17.014′E, 1324 m alt., on rock, growing together with *Caloplaca subsoluta*, 2009 Hur CH090318 (KoLRI 10932); CH090321 (KoLRI 10935); CH090322 (KoLRI 10936); 42°01.011′N 116°17.738′E, 1434 m alt., on rock growing together with *Protoparmeliopsis muralis*, 2009 Hur CH090332 (KoLRI 10946); Xilin county, Mountain, 43°36.272′N 116°43.242′E, 1260 m alt., on rock, 2009 Hur CH090347 (KoLRI 10961), CH090352 (KoLRI 10966); growing together with *Candelariella* sp. and *Rhizoplaca chrysoleuca* damaged by *Zwackhiomyces zarei*, CH090357 (KoLRI 10971). **UZBEKISTAN.** Along Dugave River, 23 August 1950 N. Shafeev 97 (MSK-L).

Molecular phylogeny — Our ITS rnDNA analyses (Pl. 1) show *Sedelnikovaea baicalensis* as closely related to *Steinia* Körb. and *Pycnora* Hafellner (*Lecideaceae* or *Lecanoromycetidae* incertae sedis), while our mt DNA analyses (Pl. 2) place the species with *Boreoplaca* Timdal (*Lecanoraceae*)

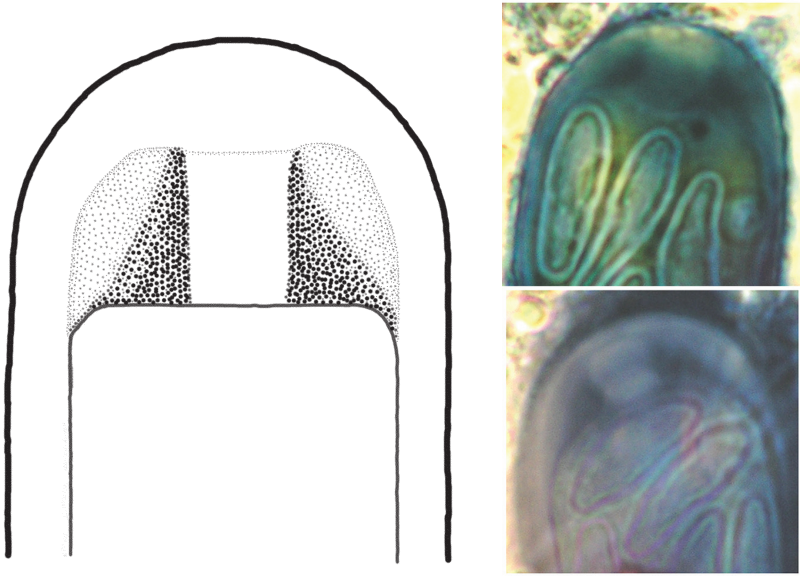

Plate. 3. Asci of *Sedelnikovaea* type.

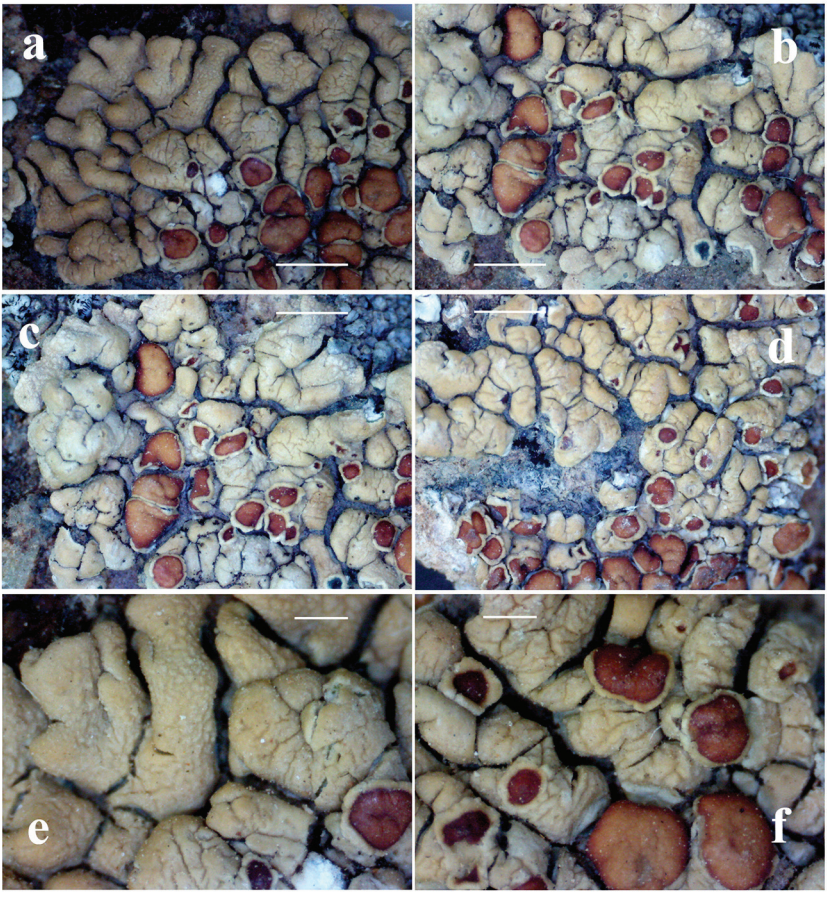

Plate. 4. *Sedelnikovaea baicalensis*. a–d. General habit; e. Enlarged portion of thallus; f. Apothecia. Scale bars: a–d = 3 mm; e, f = 1 mm.

and *Lobothallia* (Clauzade & Cl. Roux) Hafellner (*Megasporaceae*). Our combined ITS + 12S mt SSU phylogenetic analysis suggest that *Sedelnikovaea* is most closely related to genera representing several different families: *Boreoplaca* (*Lecanoraceae*), *Steinia* (*Lecideaceae* or *Aphanopsidaceae*), *Pycnora* (*Lecideaceae*), and *Lobothallia* (*Megasporaceae*). Unfortunately GenBank does not contain both nuclear and mitochondrial sequences for the same species in each of the four genera so that we can only infer that the new genus is unique. Nonetheless, our data confirm that *Sedelnikovaea* is only distantly related to *Protoparmeliopsis*.

Type of ascus — The *Sedelnikovaea*-type ascus shares some characters with the *Lecanora*-, *Candelariella*-, and *Biatora*-type asci. The *Sedelnikovaea*-type shares the strongly thickened apex with a K/I+ pale blue apical dome and a broad K/I– apical cushion found in the *Lecanora* and similar *Candelariella* types (Edwards et al. 2009). Furthermore, the apical cushion is surrounded by a narrow, deeply K/I+ blue zone as seen in the *Biatora*-type (Printzen & Coppins 2009) (Pl. 3). Unlike the *Candelariella*-type, *Sedelnikovaea* asci have only a narrow deeply K/I+ blue zone around the basal part of the apical cushion, unlike the uniformly deep blue apical cushion of *Candelariella.* The *Biatora*-type ascus is distinguished by a narrowly conical K/I– apical cushion that contrasts with the broad cushion found in *Sedelnikovaea*.

As shown above, *Sedelnikovaea baicalensis* shows the highest affinity with *Steinia* and *Pycnora* according to nuclear DNA and with *Boreoplaca* and *Lobothallia* according to mitochondrial DNA. *Pycnora* and *Boreoplaca* are characterized by a *Lecanora*-type ascus (Coppins 2009), while *Megaspora* and *Lobothallia* are characterized by the *Biatora*-ascus type (James & Fletcher 2009). Among the genera mentioned, *Steinia* alone possesses a thin-walled *Aphanopsis*-type ascus (Fletcher et al. 2009). According to Wolseley & Purvis (2009) the *Aphanopsis* ascus is similar to the *Trapelia*-type, but this possibly requires confirmation with fresh material. *Aphanopsis* and *Steinia* represent a separate family, *Aphanopsidaceae.* Finally, we should note that correlation between ascus type and DNA-phylogeny is generally poor in the *Lecanorales* (Ekman et al. 2008).

Our data on Russian, Uzbek, and Chinese material of *Sedelnikovaea baicalensis* completely agrees with the description published in the 'Handbook of the Lichens of the USSR' (Kopachevskaya 1971, as *Placolecanora baicalensis*), with the exception that the asci we measured were much wider: (13–)15–18 (–20) µm vs. 8.5–10.2 µm according to Kopachevskaya (1971).

Sedelnikovaea baicalensis usually grows on open, well-illuminated rock surfaces where it is often associated with *Dimelaena oreina*, *Lecanora frustulosa, Pleopsidium chlorophanum*, *Aspicilia transbaicalica, Aspicilia cinerea, Candelariella vitellina*, and *Rhizoplaca chrysoleuca.*

Additional molecular analyses of *Protoparmeliopsis* and *Sedelnikovaea* will most likely reveal further species that belong in *Sedelnikovaea*.

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